~~MAGNAVOX GOVERNMENT & INDUSTRIAL 6189~~

MANUAL FOR AN MW-14A

INDIANA INSTITUTE OF TECHNOLOGY

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MANUAL

FOR

D. C. HIGH VOLTAGE CONTINUITY TESTER
(MW-14A)

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D. C. HIGH VOLTAGE CONTINUITY TESTER

1. SPECIFICATIONS

The NEMA High Voltage Continuity Tester shall consist of a regulated D.C. power supply, a fault detector, a fault counter, a high voltage contact sheave, and wire handling equipment.

High Voltage Power Supply. The power supply shall be regulated and shall make available to the contact sheave a smooth, filtered, D.C. voltage free of transient overvoltage spikes. The open circuit test voltages available shall be 350, 500, 750, 1000, 1500, 2000, 2500, and 3000 volts. The steady-state, short circuit current shall be limited internally to 25 ± 5 microamperes at any test voltage setting. However, a 50 megohm fault resistance at the contact sheave shall not cause more than a 75% drop in voltage on the high voltage contact sheave at any voltage setting.

Fault Detector Circuit. The sensitivity of the fault detection circuit shall be such that the circuit will be as stated in the following table.

D.C. Test Voltage, Volts ± 5%	Threshold Fault Current in Microamperes ± 10%
3000	16
2500	14
2000	12
1500	10
1000	8
750	7
500	6
350	5

The speed of response of the fault detection circuit shall be 4-6 milliseconds. The fault counting circuit shall be designed to repeat at the rate of 450 ± 45 counts per minute when bare wire is passed over the contact sheave.

Fault Counter. The means for accumulating faults shall include a digital readout such as an electromechanical counter or an electronic equivalent. Means for resetting the counter to zero should be included.

High Voltage Contact Sheave. The high voltage contact to the test wire shall consist of a 2-inch (51mm) outside diameter stainless steel sheave. The "V" shaped groove shall have an included angle of 45° and a root diameter of 1.5 inches (38.1mm). The insulation to ground for this sheave shall be of high insulation resistance material, nonhygroscopic, easily cleaned, and with clearances such that flashover cannot occur at 3000 volts. All edges should be rounded to minimize corona. The test shall be led into and out of the high voltage sheave groove by two grounded metallic guide sheaves of the same diameter and groove centers from the contact sheave and enough below the line of centers to effect a wire wrap of 1 inch on the contact sheave. A surge damping resistor of 4.7 ± 10% megohms shall be installed in the high voltage line at the sheave connection. No high voltage line shielding shall be used. This minimizes capacitance current during switching and counting events.

Wire Handling System. The unit shall be capable of handling wire sizes 14 through 30 AWG. Dual electrode sheaves shall replace the single electrode sheave described above, for sizes 31-44 AWG. The test wire shall be pulled through the high voltage contact area at a speed of 60 ± 3 feet (18.3 meters ± 0.9 meters) per minute. The foot counter and high voltage circuit is de-energized after desired specimen length has been tested. The wire drive unit shall be a brushless type gearhead motor without speed governor.

Definitions

Fault--A fault shall be a defect or series of defects with reduced electrical properties such that, under voltage, sufficient current flows to activate the fault detection circuit.

Test Voltage--The test voltage is the open circuit voltage applied to the contact sheave. This voltage shall be checked with a high impedance voltmeter such as a D.C. electrostatic voltmeter. The test voltage collapses instantaneously with each fault event and recovers rapidly following this occurrence.

Fault Detection Current--The fault detection current is that current which flows from contact sheave to ground during each fault event. This current shall have a value as stated previously.

Sensitivity--The sensitivity of the device is expressed in microamperes and is that maximum current which will positively operate the detection unit when carried between contact sheave and ground. Currents below this value may operate the unit occasionally, but are not considered at the sensitivity "threshold."

2. OPERATING INSTRUCTIONS

Thread wire on lower left through felt pinchers, then over first sheave, under the center sheave and over the right sheave; then, straight across for one clockwise revolution around the inside, knurled section of the measuring drive wheel (take-up mandrel); now, up clockwise over the idler wheel (do not straighten idler wheel shaft) and then down for one clockwise revolution around the outside knurled portion of the drive wheel (take-up mandrel); now, lower pinch arm assembly and loop wire upward to ground at binding post on chassis.

The following are typical voltages for various wire sizes, as suggested by N.E.M.A. MW-1000, October 1984:

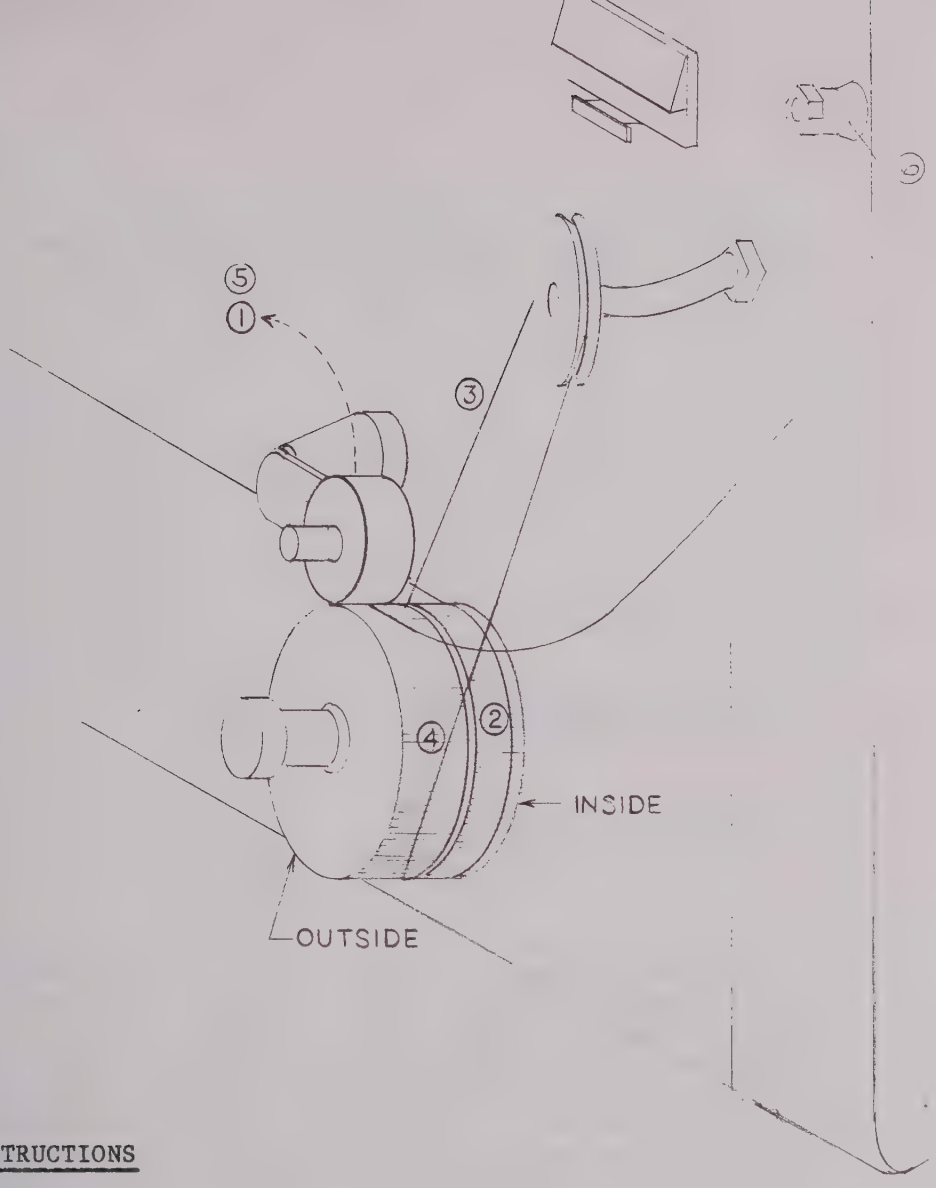
Table 1

AWG Size	D-C Voltage, Volts, ± 5 Percent		
	Single Build or Type 1	Heavy Build or Type 2	Triple Build or Type 3
Copper			
14-24	1000	1500	2000
25-30	750	1000	1500
31-35	500	750	
36-44	350	500	
Aluminum			
14-24	500	1500	----

Set the desired specimen footage by depressing, and HOLDING, the push button directly beneath the digits on the foot counter; then alternately press and release the required push buttons (above the digits) until the desired footage is indicated on the counter. (A predetermining counter is used to measure out a 100 foot specimen length or whatever length is chosen.) Release all push buttons and the counter is ready for operation. (Speed of wire is 60 feet per minute.)

After the wire is threaded, the desired voltage should be set, and the start switch operated.

After the foot counter has stopped the test, the unit can test another specimen length by depressing (momentarily) the counter knobs and then operating the start switch.



3. THREADING INSTRUCTIONS

1. Raise pinch arm assembly.

2. One clockwise revolution around the inside, knurled section of the measuring drive wheel (take-up mandrel).

3. Up clockwise over the idler wheel (do not straighten idler wheel shaft).

4. Down one clockwise revolution around the outside knurled portion of the drive wheel (take-up mandrel).

5. Lower pinch arm assembly.

6. Loop wire upward to ground at binding post on chassis.

4. LUBRICATION

IMPORTANT--Boston Gear reductor and ratiomotor have been factory lubricated and require no further maintenance. However, the drive shaft support block should be lubricated with 30 weight motor oil every six (6) months.

5. SENSITIVITY CHECK

CAUTION: All wires should have adequate insulation.

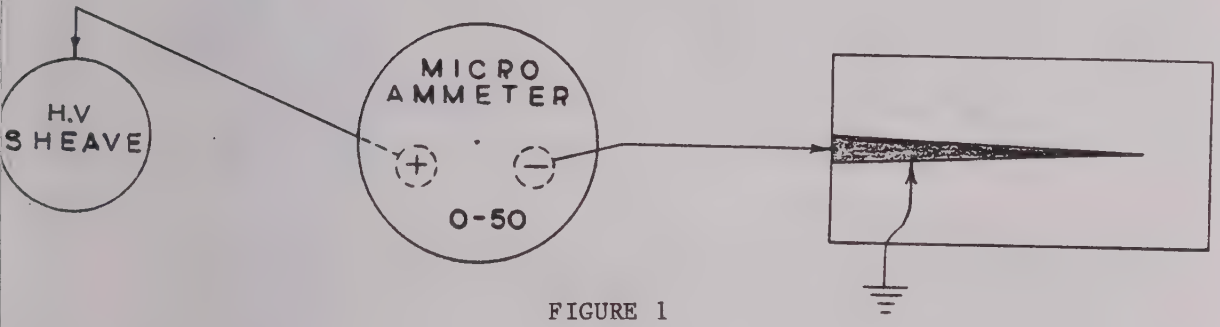


FIGURE 1

To test sensitivity at any of the voltage settings, the setup shown in Figure 1 (above) may be used. On a sheet of insulating material, using several strokes of a graphite pencil, make a line approximately 8 inches long and 1/4 inch wide. Connect wire from high voltage sheave to the positive terminal of a 0-50 microampere meter. Connect wire from the negative terminal of the meter to one end of the graphite line. Using an alligator clip/lead, attach one end to the test unit ground; then on the graphite line, starting at the point farthest from the meter, slide the loose end of the alligator clip/-lead toward the meter until the fault counter is activated. Observe the meter reading and check it against the table on Page 1.

Procedure for Adjusting Sensitivity

R7 has been preset to its mid-range position and should never require readjustment.

If the threshold fault current is not within limits at one of the voltage settings, slide the wire along the graphite line until desired current is obtained; then adjust the corresponding trimmer potentiometer, as indicated on the schematic diagram, until the fault counter is activated. Repeat for any voltage setting as required.

6. THEORY OF OPERATION

Negative Voltage Reference. A negative voltage reference is obtained by applying the output of TR2 to a voltage doubler formed by D8, D9, C7, and C8. This voltage is applied through R9 resistor to an OD3 gaseous regulator tube. R10 and R11 provide a variable voltage.

Regulated High Voltage. A high voltage source is obtained by using D7 and C2 to rectify and filter the output of the high voltage transformer TR1. R5, V1, and Q1 form a shunt regulator controlled by the voltage reference and the position into which the high voltage switch is placed. When the high-voltage switch is placed into position, it shorts out all resistors in the series string (R13-20) above it. Due to the voltage across the remaining resistors, a current flows from the high voltage supply to both the base of the transistor and to the negative voltage reference. That portion flowing to the base determines the voltage appearing from collector to emitter of the transistor. This voltage varies the cathode bias of the 6BQ6 and thus varies the amount of current drawn from the high-voltage supply through the tube and transistor. This variation in current controls the drop across R5.

If load current causes the regulated supply voltage to fall, this decreases the amount of current flowing into the base of the transistor. This causes the voltage drop from collector to emitter to increase, thus increasing the amount the grid of the tube is negative with respect to the cathode. This decreases the current through the tube, decreasing the drop across R5. If the regulated voltage rises, exactly the opposite action occurs.

The adjustment of the negative voltage reference varies the fraction of the current drawn from the high voltage which flows into the base of the transistor, thus providing a means of calibration of the high voltages.

Fault Detector Circuit. R40 and the resistor R22-R29 selected by the high-voltage switch form a voltage divider which provides a fraction of the high voltage to the fault detector. The minimum value of this voltage is determined by the sensitivity potentiometer R7, which is set so that when the high voltage falls due to a fault current, the voltage from the divider falls to half the I.C. supply voltage.

When the voltage at Pin 1 of the I.C. drops below approximately 1/2 the I.C. supply voltage, Pin 4 of the I.C. will switch to a logic "0." After a 6 millisecond delay determined by an 82K resistor and a .15mf capacitor, the voltage at Pin 13 of the I.C. will go to less than 1/2 the I.C. supply voltage and Pin 12 will go to a logic "1" state. When Pin 12 is at the "1" state, the diode connected to it is biased off. Then the multivibrator, consisting of two (2) inverters, a 4.7M resistor, 82K resistor, diode, 470K resistor, 1 meg pot, and a .15mf capacitor, will start running. The output of this multivibrator at Pins 6 and 9 will be negative-going pulses about 15 milliseconds wide and at a rate adjustable by the 1 meg pot.

When a pulse is present at the output of the multivibrator, Pin 6 is at the "0" state; therefore, the diode between Pins 6 and 13 is biased ON and Pin 13 is held at a "0" state no matter what the logic state of Pin 4 is. At this same time, the diode between Pins 9 and 11 is biased OFF and Pin 11 is allowed to fall into the "0" state. Pin 10 is then switched to a "1" state, the MM420 transistor is turned ON, and a fault is registered on the counter.

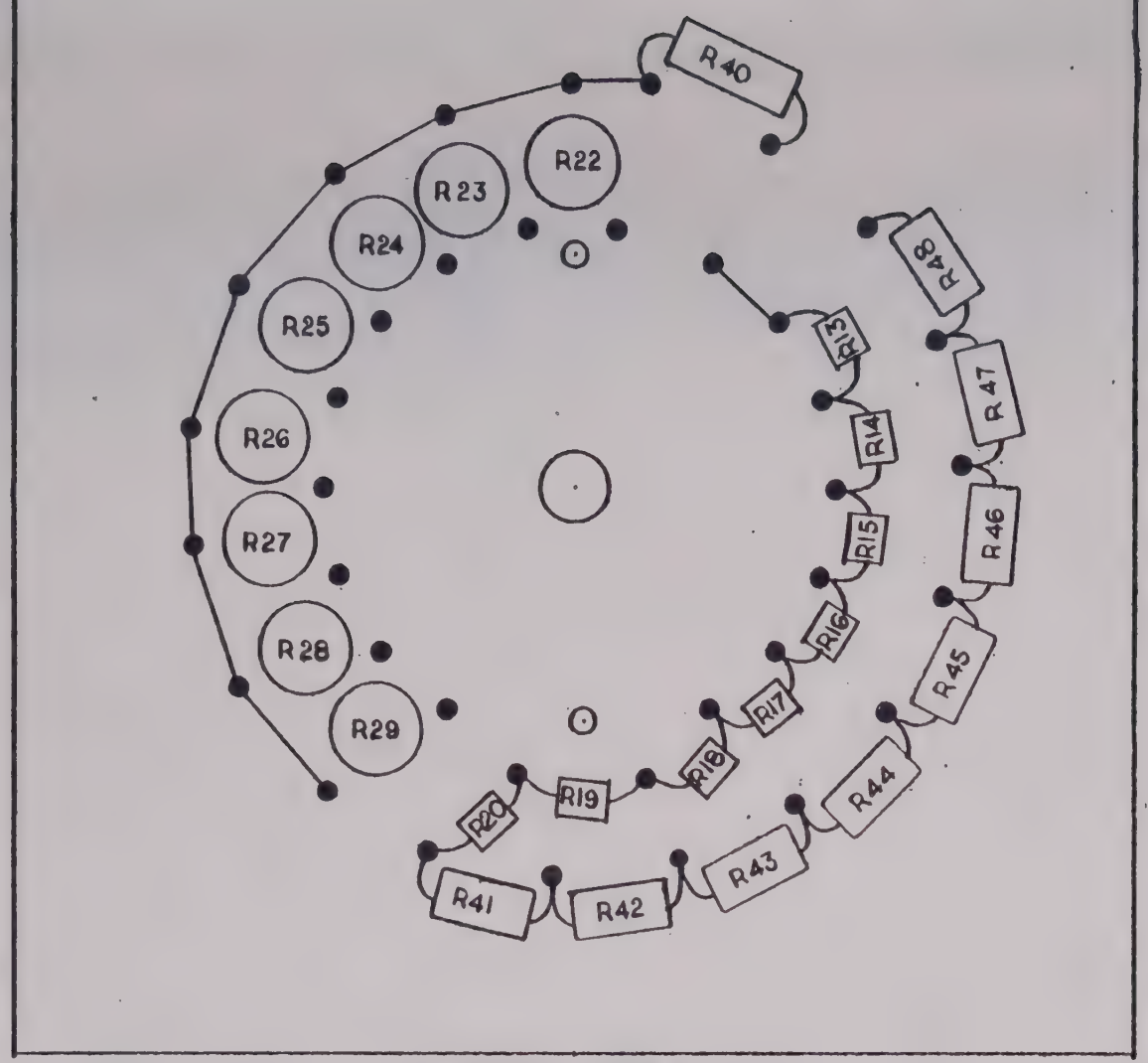
When the 150V D.C. supply is turned on, the .05mf capacitor will charge through the 3.3M and the 250K resistor. While this capacitor is charging, Pin 11 will be held at a "1" state, thus preventing any erroneous faults being registered just after the unit is started.

The diode between the I.C. supply and Pin 1 clamps the Pin 1 input at 3.6 volts, protecting this input in case the unit is operated with the high-voltage switch between taps.

7. PARTS LIST

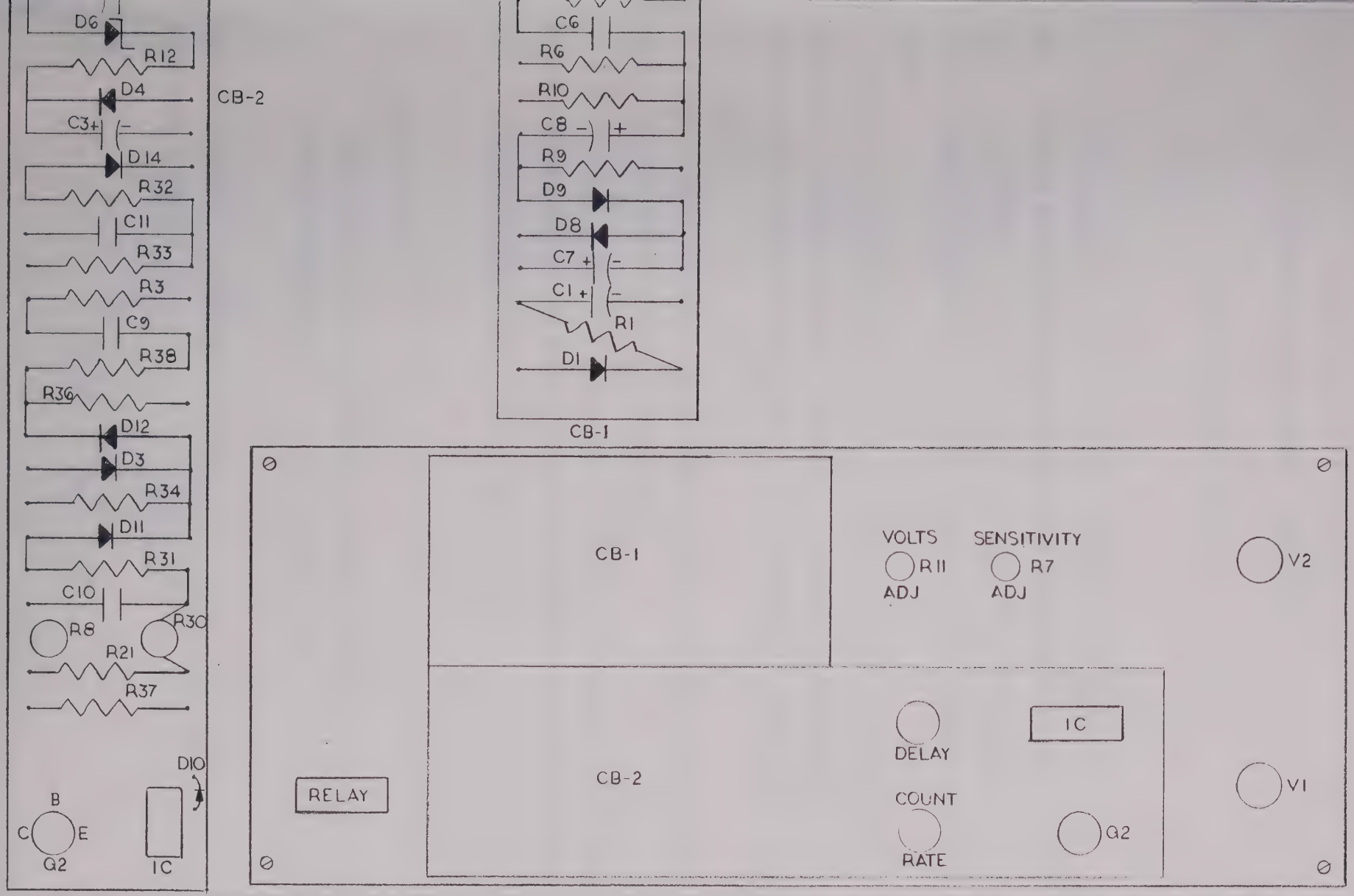
D6	1N5227B, 3.6V Zener Diode
D7	VF5-15, 5 Ma. 15,000 P.I.V. Varo Diode
Fault Counter	Sodeco #RG162E, 110V D.C., 3900 ohms
Foot Counter	Sodeco #RP112E, 110V D.C., 3000 ohms
S3A, S3B	Type 160312 Switchcraft
Power Switch	Cutler-Hammer Switch #7580K6
	*Cutler-Hammer Switch #7590K6
S2	Microswitch #BZ-2RW822-A2
S4	Centralab #JV-9034, 4 Pole, 2-3 Pos. Shorting
1C	RCA #CD4069UB Hex Inverter
Motor	Boston Gear #AAS
Gear Box for Motor	Boston Gear #F309-B-30-G
Power Lamp	#10S6 Bulb
Q1	#ECG 199 Transistor
Q2	#MM420, Motorola Transistor
TR1	Transformer 5020S
TR2	Stancor #PA8421
TR3	*General Electric Type 9151B136
RY1	Potter-Brumfield Type KA11AG, 120V A.C., 10 Amp
Fuse	3 amp, 3AG, Slo-Blo
Fuse	*1.5 amp, 3AG, Slo-Blo

*Use for 220 volt only



COMPONENT SIDE

INDIANA INSTITUTE OF TECHNOLOGY R&D		DWG#MW-14A	SCALE : AS SHOWN
TITLE : H.V BOARD ASSEMBLY	DRAWN BY : PAHALA SIPAHUTAR		DATE 7-30-82



INDIANA INSTITUTE OF TECHNOLOGY R&D	DWG #MW – 14A	SCALE : NONE
TITLE : LAY OUT DIAGRAM	DRAWN BY : PAHALA SIPAHUTAR	DATE : 10-31-83

INDIANA INSTITUTE OF TECHNOLOGY

RESEARCH AND DEVELOPMENT LABORATORIES

ONE-YEAR LIMITED WARRANTY

The test instrument designated below is warranted as sold for one (1) year, following the date of shipment, excluding heating elements and solder pots when applicable. The warranty applies against all defects of material or workmanship which develop for any reason except customer negligence and/or abuse.

The R & D Laboratories will, at its option, repair, replace, or otherwise make reasonable adjustment when an R & D inspection discloses that such defects occurred in normal use within one (1) year from the date of the original shipment.

After warranty repair, such unit will continue the remainder of the warranty period of the original test instrument.

As a matter of warranty policy, the Research and Development Laboratories will not be responsible for shipping charges incurred for warranty repair and will not accept returns without prior authorization.

Warranted Unit:

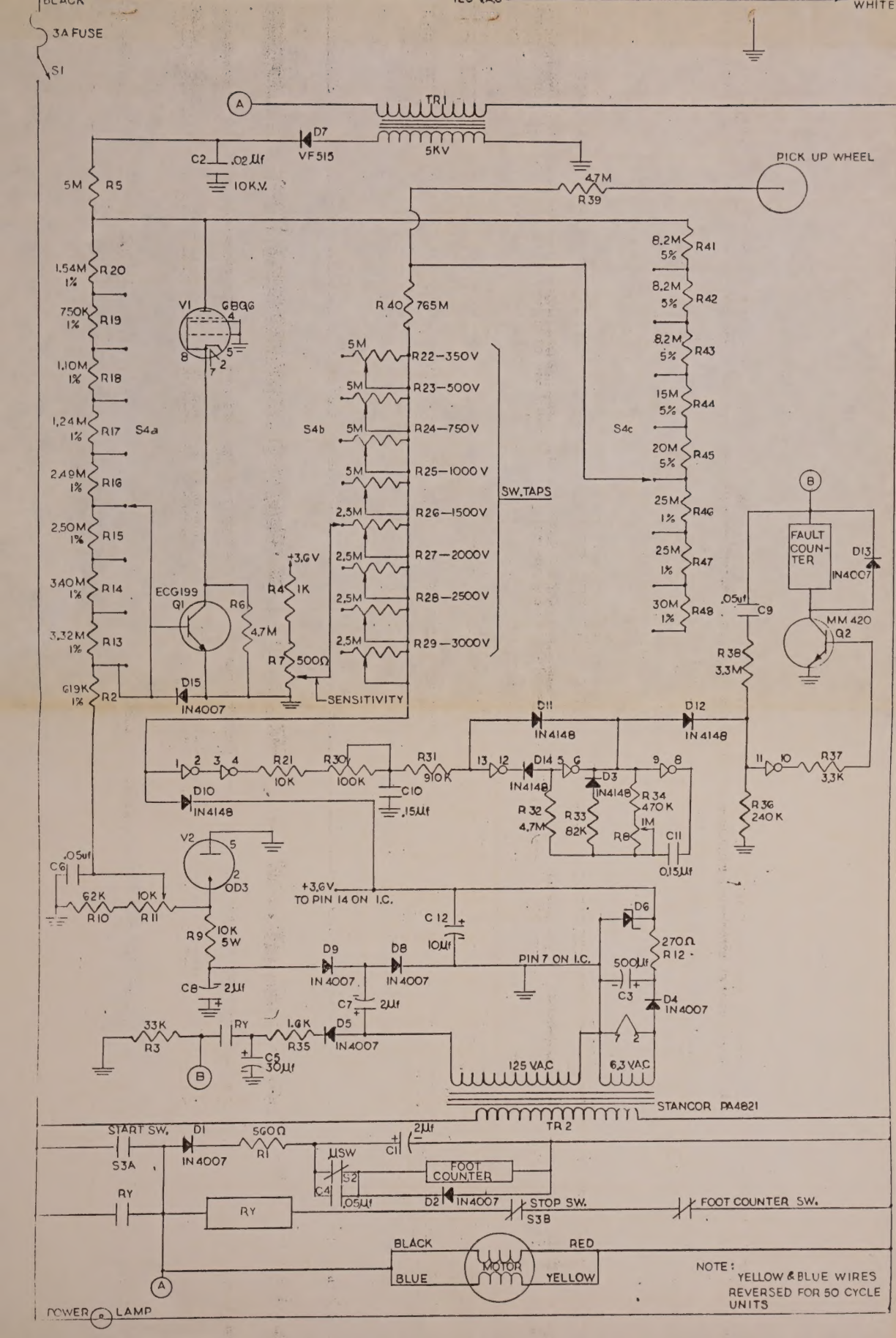
Model MW-14A, D.C. HIGH VOLTAGE CONTINUITY TESTER

Serial Number 6109

Date of Shipment JANUARY 31, 1986

Authorized Signature Richard B. Duke

Richard B. Duke
Director


BLACK
WHITE
3A FUSE
S1
A
TR1
D7
VF515
5KV
C2 .02 µf
10K.V.
PICK UP WHEEL
5M R5
4.7M
R39
8.2M 5% R41
8.2M 5% R42
8.2M 5% R43
15M 5% R44
20M 5% R45
25M 1% R46
25M 1% R47
30M 1% R48
1.54M 1% R20
750K 1% R19
1.10M 1% R18
1.24M 1% R17
2.49M 1% R16
2.50M 1% R15
340M 1% R14
3.32M 1% R13
619K 1% R2
V1 6BQ6
R40 765M
S4a
S4b
S4c
5M R22—350V
5M R23—500V
5M R24—750V
5M R25—1000V
2.5M R26—1500V
2.5M R27—2000V
2.5M R28—2500V
2.5M R29—3000V
SW. TAPS
+3.6V
R4 1K
R7 500Ω
SENSITIVITY
ECG199 Q1
R6 4.7M
D15 IN4007
FAULT COUNTER
D13 IN4007
.05µf C9
MM 420 Q2
R38 3.3M
B
D11 IN4148
D12 IN4148
R21 10K
R30 100K
R31 910K
C10 .15µf
D10 IN4148
D14 IN4148
D3 IN4148
R32 4.7M
R33 82K
R34 470K
R8 1M
C11 0.15µf
R36 240K
R37 3.3K
V2 OD3
C6 .05µf
62K R10
10K R11
R9 10K 5W
+3.6V TO PIN 14 ON I.C.
C12 10µf
D9 IN 4007
D8 IN 4007
PIN 7 ON I.C.
D6
270Ω R12
500µf C3
D4 IN4007
C8 2µf
C7 2µf
33K R3
RY
1.6K R35
D5 IN4007
C5 30µf
125 VAC
6.3 VAC
STANCOR PA4821
TR2
START SW. S3A
D1 IN4007
560Ω R1
2µf C11
µSW S2
C4 .05µf
FOOT COUNTER
D2 IN4007
STOP SW. S3B
FOOT COUNTER SW.
RY
BLACK
RED
BLUE
YELLOW
MOTOR
NOTE: YELLOW & BLUE WIRES REVERSED FOR 50 CYCLE UNITS
POWER LAMP